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Measurements of NO and total reactive odd-nitrogen, NOy,
in the Antarctic Stratosphere

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Measurements of NO and total reactive nitrogen, NO_y, were made as part of the Airborne Antarctic Ozone Experiment conducted in Punta Arenas, Chile during August and September 1987. The total reactive nitrogen reservoir includes the species NO, NO₂, NO₃, N₂O₅, HNO₃, and ClONO₂. The instrument was located on board the NASA ER-2 aircraft which conducted twelve flights over the Antarctic continent reaching altitudes of 18 km at 72 S latitude. The NO_y technique utilized the conversion of component NO_y species to NO on a gold catalyst and the subsequent detection of NO by the chemiluminescence reaction of NO with ozone. Since the inlet sample line is heated and the catalyst operates at 300 C, NO_y incorporated in aerosols evaporates and is converted to NO. NO was measured on two separate flights by removing the catalyst from the sample inlet line.

The NO_y values between 15 - 20 km pressure altitude and between 53 and 64 S latitude were in the range 8 - 12 parts per billion by volume (ppbv). The corresponding NO values were between 0.1 and 0.2 ppbv. These values are in reasonable accord with the results of 2-D models that are zonally symmetric and incorporate only homogeneous chemistry.

At latitudes near 64 S, large latitude gradients of NO and NO_y were often found. When the aerosol NO_y component was low, NO_y values dropped to the range of 0.5 - 4 ppbv within several degrees of latitude. NO values declined similarly to levels below the detection limit of ~0.03 ppbv. In addition, the altitude gradient of NO_y was small at the highest latitudes between 15 and 20 km. The latitude region > 64 S is the center of the polar vortex and the region of perturbed chemistry as defined by the observed ClO levels.

The discussion of the results will address low NO_y levels as evidence of the systematic removal of NO_y from the stratosphere, the partitioning of residual NO_y in the vortex between HNO₃ and ClONO₂, and calculations of the steady state between NO, O₃, and ClO used to determine the abundance of NO₂ and ClONO₂ inside and outside the vortex.